Description

SYSTEM AND METHOD FOR TRANSMITTING RANDOM ACCESS DATA USING ORTHOGONAL FREQUENCY DIVISION MULTIPLE ACCESS

Technical Field

[1] The present invention relates to a system and methodfor transmitting random access data using OFDMA (orthogonal frequency divisionmultiple access.) More specifically, the present invention relates to a systemand method for transmitting random access data using OFDMA for allowing aplurality of mobile stations to transmit burst-characterized data through anuplink common channel for the purpose of effective usage of resources.

Background Art

[2] A wireless mobile communication system divides atotal resource such as frequency bands or data rates into many smaller ones,schedules them according to respective users ' requests, and thus shares theresource by using multiple access methods such as time division, frequencydivision, and code division.

[3] The method for a plurality of mobile stations totransmit intermittent data through an uplink common channel for the purpose ofeffective usage of resources is a random access method for allowing all themobile stations to have transmission rights and transmit data randomly.

[4] One of the random access methods is to allow amobile station to transmit a preamble to a base station in advance. Thepreamble is generated by using a randomly selected code from amongdistinguishable codes. After having received a corresponding access grant onthe preamble from the base station, the mobile station transmit the actualrandom access data.

[5] The above-noted method for transmitting randomaccess data allows the preamble and the data to be transmitted through a commonrandom access channel, and additionally requires resource assignment.

[6] Further, one of methods for responding to thepreamble transmitted from the mobile station is to use the code which isreceived when an access grant signal is generated, and re-transmit thepreamble. Another one is to use code and channel information which is capturedat the time of receiving the preamble.

[7] Since a lesser amount of resources is needed fortransmitting the preamble, it is allowable to assign a lesser amount ofresources irrespective of a random access request

by the mobile station.However, it is inefficient to assign the transmission resource for transmissionof random access data irrespective of a random access request by the mobilestation.

Disclosure of Invention

Technical Problem

[8] It is an advantage of the present invention to transmit ACK/NACK information including a scheduling ID when a base station responds to a preamble of a random access mobile station.

[9] It is another advantage of the present invention to provide a system and method for transmitting random access data using OFDMA for allowing a base station to assign a specific ID to each preamble when receiving the preamble, variably assign a channel for transmitting random access data according to resource assigned conditions, and notify a mobile station of assignment of the channel resource by using ID.

Technical Solution

[10] In one aspect of the present invention, provided is a random access data transmission system using OFDMA between a mobile station and a base station, wherein the mobile station comprises: a resource selector for randomly selecting a preamble transmission channel and a code; a preamble transmitter for generating a preamble based on the transmission resource information selected by the resource selector and transmitting the preamble to the base station through a preamble transmission channel; a preamble access grant processor for receiving and processing acknowledgment or non-acknowledgment information including a scheduling ID contained in the preamble access grant from the base station; and a data transmitter for transmitting random access data through a data transmission channel assigned to the mobile station based on the information processed by the preamble access grant processor.

[11] In another aspect of the present invention, provided is a random access data transmission system using OFDMA (orthogonal frequency division multiple access) between a mobile station and a base station wherein the base station comprises: a preamble receiving processor for receiving a preamble from the mobile station and extracting corresponding preamble information; an ID manager for assigning a specific scheduling ID to each mobile station and managing the specific scheduling ID so that the mobile station may use a assigned data transmit channel; a scheduler for scheduling a data transmission time, and a transmission quantity of the mobile station with the scheduling ID assigned to the mobile station by the ID manager according to

channel environments and requirements of the mobile stations; an access grant processor for determining an acknowledgment/non-acknowledgment status based on the preamble information of the preamble receiving processor and the scheduling ID of the ID manager, and transmitting preamble access grant configuring information including the scheduling ID to the mobile station; and a data receiving processor for receiving the random access data through a assigned data transmission channel from the mobile station according to a transmission result of the access grant processor, and processing them.

[12] The ID manager recovers the scheduling ID assigned to the mobile station when the data receiving processor finishes receiving of transmitted random access data .

[13] In still another aspect of the present invention, provided is a random access data transmission method using OFDMA between a mobile station and a base station, wherein the procedure of mobile station comprises: (a) selecting a preamble transmission channel and a transmission radio resource related to a code used for transmitting a preamble for a random access to the base station; (b) generating a preamble and transmitting the preamble to the base station using the transmission radio resource selected in (a); (c) receiving preamble access grant configuring information including a scheduling ID and acknowledgment/ non-acknowledgment information assigned by the base station with respect to the preamble transmitted in (b), and checking a success or failure in transmission of the preamble, and the scheduling ID; and (d) allowing the mobile station to check an assignment of the data transmission channel by using the mobile station ' s scheduling ID included in a control channel according to a checking result in (c), and transmitting random access data to the base station through the data transmission channel assigned to the mobile station.

[14] In step (d), the mobile station uses extracted transmission control information related to timing, a frequency, and power from the access grant information received in (c) to transmit random access data.

[15] In still yet another aspect of the present invention, provided is a random access data transmission method using OFDMA between a mobile station and a base station, wherein the procedure of base station comprises: (a) allowing the base station to receive and analyze a preamble transmitted from the mobile station, and assigning a specific scheduling ID when the mobile station can be scheduled; (b) determining an acknowledgment or a non-acknowledgment and forming preamble access grant configuring information according to the preamble information analyzed in (a) and an assigned status of the scheduling ID, and transmitting the preamble access grant

configuring information to the mobile station; (c) allowing the base station to schedule a data transmission time, a transmission channel, and a transmission quantity of each mobile station according to the mobile stations ' channel environments and requirements, and notifying the mobile station of scheduled results by using scheduling ID; and (d) receiving random access data from the mobile station corresponding to the scheduling ID determined in (c) through the data transmission channel, and processing the random access data.

[16] The step (d) comprises recovering the scheduling ID assigned to the mobile station when the reception of the random access data transmitted from the mobile station is finished.

Advantageous Effects

[17]

Description of Drawings

[18] The accompanying drawings, which are incorporatedin and constitute a part of the specification, illustrate an embodiment of theinvention, and, together with the description, serve to explain the principlesof the invention:

[19] FIG. 1 shows a configuration diagram of a randomaccess data transmission system using OFDMA according to a preferred embodimentof the present invention;

[20] FIG. 2 shows a configuration of an uplink frameaccording to a preferred embodiment of the present invention;

[21] FIG. 3 shows a configuration of a downlink frameaccording to a preferred emb odiment of the present invention; and

[22] FIG. 4 shows a data transmission process of therandom access data transmission method using OFDMA according to a preferredembodiment of the present invention.

Best Mode

[23] In the following detailed description, only thepreferred embodiment of the invention has been shown and described, simply byway of illustration of the best mode contemplated by the inventor(s) ofcarrying out the invention. As will be realized, the invention is capable ofmodification in various obvious respects, all without departing from theinvention. Accordingly, the drawings and description are to be regarded asillustrative in nature, and not restrictive. To clarify the present invention,parts which are not described in the specification are omitted.

[24] A random access data transmission system usingOFDMA according to the preferred embodiment of the present invention will bedescribed in detail with reference to FIG. 1.

[25] FIG. 1 shows a configuration diagram of a randomaccess data transmission system using OFDMA according to a preferred embodimentof the present invention, FIG. 2 shows a configuration of an uplink frameaccording to a preferred embodiment of the present invention, and FIG. 3 showsa configuration of a downlink frame according to a preferred embodiment of thepresent invention.

[26] As shown in FIG. 1, when using the random accessmethod including the case in which a mobile station registers to a cell for thefirst time, the case in which the mobile station requests a state transition,and the case in which the mobile station requests a handover from one cell toanother, the random access data transmission system using OFDMA assigns ascheduling ID included in downlink access grant transmitted by the base station200 to the uplink preamble transmitted by the mobile station 100 so that themobile station may transmit the random access data to the base station 200through a data transmission channel assigned to the scheduling ID.

[27] For this purpose, the mobile station 100 comprisesa resource selector 110, a preamble transmitter 120, a preamble access grantreceiving processor 130, and a data transmitter.

[28] The resource selector 110 selects transmissionradio resources like codes, preamble transmission channel for transmitting thepreamble for a random access to the base station codes.

[29] The preamble transmitter 120 generates a preambleby using information on the transmission radio resource selected by theresource selector 110, and transmits the corresponding preamble to the basestation through the preamble transmission channel.

[30] In the OFDMA/FDD system which uses differentfrequency bands for uplinks and downlinks, the preamble transmitter 120 fixes aspecific slot in an uplink frame for an available time of preambletransmission. An uplink frame is made up a plurality of slots. Radio frequencyresources of the specific slot are divided into a plurality of subchannels.The preamble transmitter 120 transmits the preamble which is generated by usingthe code which is distinguishable from a mong the different codes through thesubchannel randomly selected from among the subchannels.

[31] In this instance, slots of the uplink frame exceptthe slot which is fixed for transmitting the preamble are divided into controlinformation transmission channels and data transmission channels, and therandom access data are loaded on part of the data transmission channel andtransmitted to the base station 200.

[32] As shown in FIG. 2, the uplink frame having apredetermined length of Tframe comprises a plurality of slots wherethe length of the slots is Tslot , excluding the final

slot having alength of Tslot' .

[33] The possibility of each slot ' s transmission ofthe random access preamble is determined according to the position of the slotin the frame. When the preamble transmission position is defined to be thefinal slot within the frame, the final slot of the frame is fixed to the timefor transmitting the preamble, and the radio resources of the slots are dividedinto subchannels and are then used.

[34] The mobile station 100 randomly selects one of theradio resources which are divided as the subchannels at the time oftransmitting the preamble, uses the code which is distinguishable by differentcodes , and transmits the generated preamble to the base station 200.

[35] The slots except the final slot are divided intocontrol information transmission channels and data transmission channels. Achannel for transmitting the random access data is not classified as a separatetransmission channel, and the random access data are transmitted by using partof the data transmission channels.

[36] The preamble access grant receiving processor 130receives a preamble access grant including a scheduling ID and ACK/NACKinformation on the preamble from the base station 200 according to thetransmission by the preamble transmitter 120, and processes them.

[37] The data transmitter 140 transmits the randomaccess data to the base station 200 through the data transmission channel ofthe scheduling ID assigned to the mobile station 100 based on the informationprocessed by the preamble access grant receiving processor 130.

[38] The base station 200 comprises a preamble receivingprocessor 210, an ID manager 220, a scheduler 230, an access grant processor240, and a data receiving processor 250.

[39] The preamble receiving processor 210 receivespreambles from the respective mobile stations 100, and extracts preambleinformation including codes, timing, and power through the preambles.

[40] The ID manager 220 assigns a specific scheduling IDto each mobile station 100 and manages it so that the mobile station 100 mayuse a data transmission channel specified by the base station 200, and alsorecovers and manages the scheduling ID assigned to the mobile station when thedata receiving processor 250 finishes receiving of transmitted random accessdata.

[41] The scheduler 230 assigns the resources of thepacket service, and in detail, it considers requirements including a channelenvironment and QoS of the mobile

stations, and determines transmission timesand quantities of the mobile stations to which the scheduling IDs are givenaccording to a scheduling algorithm.

[42] The access grant processor 240 loads preambleaccess grant information in a specific slot of the downlink frame including aplurality of slots, and transmits the same to the mobile station 100.

[43] As shown in FIG. 3, the downlink frame includes aplurality of slots having a constant length Tframe , and it has thesame length as that of the uplink frame.

[44] The slots of the downlink frame comprises a slotTslot' for synchronization and cell search, and downlink trafficslots Tslot which include a transmission time of data traffic and atransmission time of control signal traffic.

[45] The period of physical channels for transmittingthe control signal traffic can be a multiple of the frame period, whichrepresents that the data configured by block units are partially divided andtransmitted for each slot.

[46] The data transmitted to the downlink through thechannel at the transmission time of the control signal traffic includebroadcasting information, paging information, state management information, anddata transmission control information.

[47] Since control signal information channels fortransmitting the control signal information divide and use the orthogonalfrequencies because of characteristics of the OFDMA system, a preamble accessgrant channel for transmitting access grants on the preamble transmission canbe configured with N subchannels from among the channel.

[48] It is required to use the restricted radioresources with an appropriate ratio and purpose, and the assignment ratio ofthe resources is varied according to the cell configuration in the OFDMAsystem.

[49] Therefore, it is desirable for the base station toseparately notify the mobile station of configuration information of a preambleaccess grant channel, use the configuration information of the preamble accessgrant channel, and allow the mobile station to check the preambleacknowledgements ACK/NACK so that the base station may effectively manage thechannel for transmitting the access grant of the preamble, compared to themethod for fixing part of the control signal information channel to be apreamble access grant channel in consideration of the maximum value of therandom access request available in the existing cell.

[50] The data receiving processor 250 receives andprocesses the random access data transmitted by the mobile station 100 whichhas received the access grant of the access grant processor 240.

[51] An operation of the random access data transmissionsystem using OFDMA

according to a preferred embodiment will now be describedwith reference to a drawing.

[52] FIG. 4 shows a data transmission process of therandom access data transmission method using OFDMA according to the preferredembodiment of the present invention.

[53] As shown in the random access data transmissionmethod using OFDMA, the resource selector 110 of the mobile station 100initially selects a transmission radio resource used for transmitting thepreamble in step S1.

[54] The preamble transmitter 120 receives informationon the transmission radio resource selected by the resource selector 110,generates a preamble, and transmits it to the base station 200 through apreamble transmission channel in step S2.

[55] The preamble receiving processor 210 of the basestation 200 analyzes the preamble received through the preamble transmitter120, extracts preamble information including codes, timing, and power, and theID manager 220 assigns a scheduling ID to the mobile station to be scheduled instep S3.

[56] The access grant processor 240 determinesacknowledgment/non-acknowledgment status on the preamble provided from themobile station according to the preamble information extracted from thepreamble receiving processor 210 and assigned status of the scheduling IDprovided by the ID manager 220.

[57] The access grant processor 240 configures preambleaccess grant configuring information by using the scheduling ID information,ACK/NACK information, and preamble information extracted from the preamble, andtransmits the preamble access grant configuring information which is accessgrant information to the mobile station 100 through the control informationtransmission channel specified by the base station 200 in step S4.

[58] The preamble access grant receiving processor 130of the mobile station 100 receives the preamble access grant configuringinformation from the access grant processor 240 through the preambleacknowledgement channel, and checks successful preamble transmission status andthe scheduling ID in step S5.

[59] When finishing transmission of the preamble accessgrant configuring information, the base station 200 transmits assignmentinformation of the data transmission channel determined after schedulingtogether with the scheduling ID assigned to a random access mobile station 100by the scheduler 230 to the mobile station 100 through the control informationtransmission channel in steps S6 and S7.

[60] The random access mobile station 100 checksassigned status of the data transmission channel of the scheduling IDtransmitted through the control channel in

step S8, and transmits the randomaccess data through the data transmission channel assigned to the mobilestation 100 in step S9.

[61] In this instance, the mobile station 100 minimizesthe influence given to the data transmitted to the base station by anothermobile station by using transmission control information including timing, afrequency, and a power received through the preamble access grant configuringinformation, and transmits the random access data through the data transmissionchannel.

[62] When the base station 200 finishes receiving therandom access data through the data receiving processor 250, the ID manager 220recovers and manages the scheduling ID assigned to the corresponding mobilestation in step S10.

[63] As described, the base station 200 assigns datatransmission channels for variably transmitting the random access dataaccording to assigned resource status to the access grant of the preambletransmitted from the mobile station.

[64] To achieve this, the base station 200 provides aspecific scheduling ID for each preamble when transmitting an access grant onthe preamble received from the mobile station to the downlink, and notifies themobile station of assignment information on the data transmission channeldetermined through the scheduling ID.

[65] It is desirable to use the scheduling ID as anidentifier of the mobile station used by the scheduler 230 and use the same forthe physical layer and the MAC layer.

[66] In consideration of the channel condition and QoSof each mobile station, the scheduler 230 selects a mobile station to which thedata transmission channel will be assigned, and transmits correspondingassignment information through the data transmission control channel, andhence, the mobile station checks the assignment information in the datatransmission control channel through the scheduling ID assigned to the mobilestation, and transmits the random access data through the data transmissionchannel.

[67] In this instance, the data transmission channel isa channel for allowing the mobile station which is registered to the basestation and is in the active state to transmit the data.

[68] After receiving the random access data from themobile station, the base station 200 transmits them to the system through apath other than that of the data of the registered mobile station. Therefore,the OFDMA-based random access data transmission system and method according tothe preferred embodiment improves conventional inefficient usage of thetransmission resources through assigning a separate random access data-transmission channel.

[69] While this invention has been described inconnection with what is presently considered to be the most practical andpreferred embodiment, it is to be understood that the invention is not limitedto the disclosed embodiments, but, on the contrary, is intended to covervarious modifications and equivalent arrangements included within the spiritand scope of the appended claims.

[70] As described in the OFDMA-based random access datatransmission system and method, the base station loads the mobile station'stransmission control information and the scheduling ID information into theaccess grant of the preamble received from the mobile station and transmitsthem so that the mobile station may transmit the random access data through thedata transmission channel without an additional separated channel, therebyenabling effective usage of the radio resources, and transmitting the datawithout influencing data transmission of other mobile stations by using thetransmission control information.